

Figure 16. Site 19490, Feature C and Unit Location; Plan View

tube is linear and narrow (11 X 3 X 1.5 m high) and contains a rich variety of cultural material (e.g., volcanic glass, gourd fragments, bird bone, vegetable matting, charcoal, 'opihi shell, kukui, and a rock cupboard with bird bone). The most outstanding constituent is a pair of well-preserved ti leaf sandals discovered at the base of a boulder 8.5 m from the entrance. They resemble the Type A sandals defined by Buck [1957:249-252] and exhibit two stout parallel cords (without median strand) and remnants of toe and ankle straps. This type of sandal, or *kāma'a*, is also described by Krauss [1993:71-72].

The northeast end of the tube is blocked with boulders and large rocks. This rear area contains scattered charcoal and bird bone (e.g., *pterodroma phaeopygia*), especially concentrated along the wall crevices. Along the south wall is a midden area (2 X 2 m) on the soil floor containing 'opihi shell, kukui nut pieces, charcoal flecks, bird bone, and volcanic glass. A charcoal sample (Sample C9) from a burned firebrand in this region 9.3 m inside the tube produced a C13 corrected radiocarbon age of 160 ± 70 years B.P. and calibrated date of A.D. 1640 to 1950). Two, small adjacent openings from the main tube lead down a narrow toppled rock entry into a south chamber (10 X 5 X 2 m high). A continuous surface distribution of cultural debris is noted throughout the lower tube surface (e.g., bird bone, a few firebrands, vegetable mattings, gourd fragments, and a volcanic glass blade). Bird bone and gourd fragments are especially concentrated along the wall crevices.

Collected items from Feature C include fish bone and bird bone samples, charcoal, volcanic glass, and a grinding stone and pestle. Two pieces of artifact glass were submitted for source analysis and were found characteristic of the Pohakuloa Basalt/Glass chemical group [cf. Jackson and Miksicek 1994].

The ti leaf sandals recorded at Feature C are currently preserved in an acid-free box in a climate controlled curation room at PTA (K. Luscomb, personal communication 2005) (Figure 17).

Site 19490 Testing Results

A test unit was placed over an ash deposit exposed within the light zone of the chamber roughly 0.5 m east of the chamber's entrance. It lay on the west side of a low outcrop. Numerous goat droppings were observed along the floor of the blister shelter.

TU1 was excavated to a maximum depth of 45 cm below surface. Four soil layers (Layers I-IV) and a subsurface feature (SF1), including six distinguishable layers (SF1a-f) were encountered in the excavation (Figures 18-20). Although the SF1 layers were distinguished in profile, their undulating and often mixed horizontal boundaries were ambiguous during the excavation. Consequently, SF1 was excavated by arbitrary 10 cm levels, not layers. Layer designations (Layers I-IV) were assigned to what appeared to be natural or cultural layers not directly associated with the SF1 hearth. The TU1 stratigraphy is as follows:

Layer I	(2-5cm thick) very dark gray brown (10YR 3/2) silty loam, clear, smooth boundary; common rootlets; goat droppings; cultural materials present.
Layer II	(1-2cm thick) very dark gray-black (2.5Y 2.75/1) silt loam, increased fine sand, clear, smooth boundary; intermittent layer; common rootlets; cultural materials present.
Layer III	(3-10cm thick) dark gray brown (2.5Y 4/2) silt loam; common rootlets; cultural materials present.
Layer IV	(2-5cm thick) olive brown (2.5Y 4/3) silty fine sand; common rootlets; on bedrock; non cultural.
SF1a	(5-6cm thick) light gray- light brown gray (2.5Y 6.5/2) silt loam (ash component), clear, smooth boundary; few rootlets; cultural materials present.
SF1b	(2-7cm thick) grayish brown- dark grayish brown (2.5Y 4.5/2) silt loam with fine organics; clear, smooth boundary; common rootlets; cultural materials present.



Figure 17. Site 19490 Ti Leaf Sandals (*ā kama'ā*) in Curation Box (Photo taken by PTA Cultural Resources Staff)

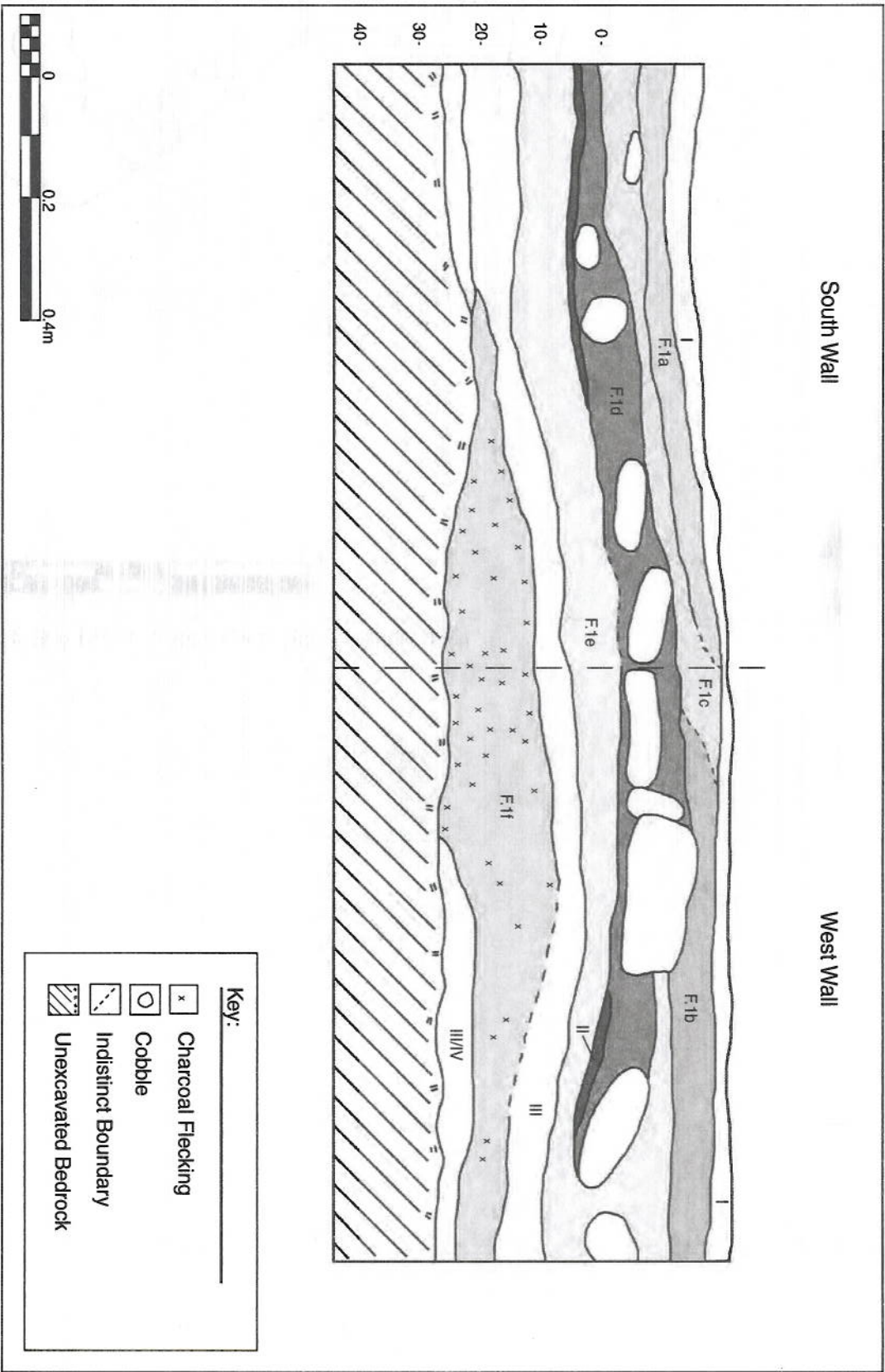


Figure 18. Site 19490; Feature C, TUI South and West Profiles



Figure 19. Site 19490, Feature C, Photograph of South Wall Profile

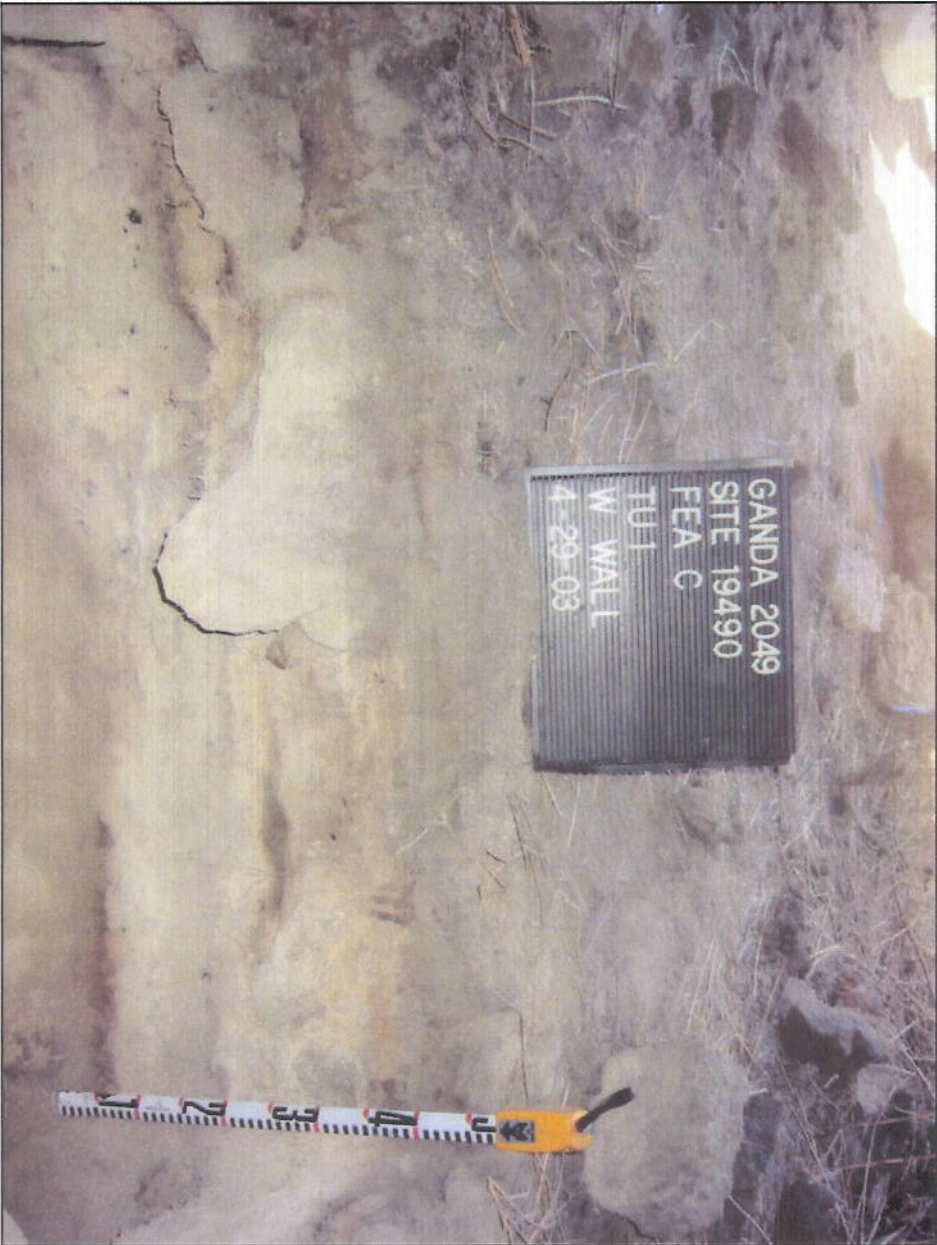


Figure 20. Site 19490, Feature C, TU-1, Photograph of West Wall Profile

- SF1c (2-6cm thick) pale brown (10YR 6/3) silt loam (decreased loam); clear, smooth boundary; few rootlets; cultural materials present.
- SF1d (3-11cm thick) grayish brown – dark grayish brown (2.5Y 4.5/2) silt loam, clear and wavy boundary, 20 % cobbles; common rootlets; charcoal flecks; cultural materials present.
- SF1e (3-21cm thick) pale brown (10YR 7/3) silt loam with fine organics; clear, smooth boundary; few rootlets; cultural materials present.
- SF1f (4-19cm thick) light gray - very pale brown (10YR 7.5/2) silt loam (ash component), clear, wavy boundary; few rootlets; cultural materials present.

SF1 is a 45-cm-thick subsurface hearth comprising multiple component layers (SF1a-f) of varying colors of ash (SF1a-c, and e), ash mixed with charcoal (SF1f) and ash mixed with charcoal and fire-affected rocks (F1d). All levels of SF1 yielded traditional cultural material, including marine shell, bird, mammal and fish bone, *kukui* nut shells, basalt and volcanic glass debitage and tools (blades, scrapers, cores and adze fragments), bird cooking stones, and bone and shell artifacts, such as needles, awls and scrapers (Table 7).

The four soil layers (I-IV) were deposited within and at the base of the hearth feature. The layers, with the exception of the culturally sterile Layer IV, contained similar types and quantities of cultural materials as the hearth.

Layer I comprises the current floor of the cave shelter and overlays three irregular ash or ash-mixed layers, designated SF1a-c. All three SF1 components appear to be mixed with Layer I, as a result of human and animal movement in the cave.

Layer II is a dark silt deposited in pockets beneath SF1d, an ash and charcoal matrix with fire-affected rocks. Based on the presence of fire-affected rocks, SF1e might be an *imu* hearth component excavated into SF1e; the latter is suggested by the bisection of SF1e by SF1d in the north half of the unit.

Layer III is a dark silt loam deposited in pockets beneath SF1e, a banded ash layer. Layer III overlies a charcoal-infused hearth layer (SF1f) in the SW quadrant of the unit and Layer IV elsewhere in the unit. Layers III and IV become mixed in the north wall of the unit, probably from human and goat movement in this central portion of the cave.

Layer IV is the basal soil layer deposited directly on the basalt floor of the cave. The layer is predominantly fine sand and predates human occupation of the cave.

Although materials were recovered from all 10-cm levels of SF1, Level 3 (20-30 cmbs), roughly correlating with the rock-filled SF1d, yielded the largest proportion of volcanic glass debitage (1,371 pieces), basalt debitage (497 pieces), and tool artifacts (50), in comparison to an average of 159 basalt debitage pieces, 21 basalt debitage pieces, and 14 tools recovered from the remaining four hearth levels.

Faunal remains, consisting mammals, fish, and both sea and land birds comprised a large part of the materials recovered from TU1, dominated (71 percent) by bird bone (Table 8). The identifiable mammal bone includes dog (*canis familiaris*), and introduced mongoose (*Herpestes auro-punctatus*), goat or sheep (*Capra hircus/Ovis* sp.) and Norwegian or Roof rat (*Rattus norvegicus* or *Rattus rattus*).

Table 7. Summary of Site 19490 TUI Cultural Materials

Layer/ SF: Depth (cm):	I 0-10	SF1 0-10	SF1 10-20	II 15-20	SF1 20-30/35	SF1 30-40	III 20-50	SF1 40-50
Marine shell	None	<i>pipipi</i>	Dotted Periwinkle, Miser Dove Shell	<i>opihī</i>	<i>opihī</i> , Miser Dove Shell	<i>'opihī</i>	<i>'opihī</i>	Dotted Periwinkle
Faunal	None	Petral, rat, fish, goat, Mongoose, game bird, Perch birds, Hawaiian Rail (extinct)	Petral, rat, fish, Short-eared Owl, Perch birds	Petral, Short- eared Owl	Petral, fish, Goat, Short- eared Owl, Perch birds, Hawaiian Rail	Petral, rat, fish, <i>nene</i> Goose, Hawaiian Rail, Perch bird	Petral, rat, dog, Short-eared owl, Hawaiian Rail, Perch bird, fish	Petral, rat, Hawaiian Rail, fish
Floral	None	Kukui	Kukui	Kukui	Kukui	Kukui	Kukui	None
Lithics	Blade	V. glass and basalt debitage blades, cores, scrapers, bird- cooking stones, adze fragments	V. glass and basalt debitage, blades, adze fragments, hammerstones, cores, and abraders.	V. glass, blade.	V. glass and basalt debitage, hammerstone, bird-cooking stone, blades, blade, cores, scrapers	V. glass and basalt debitage, bird cooking stone, hammerstone core, scraper	V. glass and basalt debitage, scraper, core, abraded, bird cooking stones, hammerstone, adze frags	Volcanic glass and basalt debitage, scraper
Charcoal	None	Present	Present	Present	Present	Present	Present	Present
Other Artifacts	None	Modified wood and bone	Shell scraper	None	Shell scraper, Tooth pendant, awls	Bone fragment	Shell scraper, Awl, needle,	None

Table 8. Volume of Faunal Remains in Site 19490 Subfeature 1 (SF1)

*Concentration Index	Weight (gm)	Common Name(s)	Class	Species
5	1.7	Short-eared Owl	Aves	<i>Asio flammeus</i>
3	1.1	Hawaiian Goose	Aves	<i>Branta sandvicensis</i>
0.3	0.1	Turkey or Peafowl	Aves	Large Galliform
1	0.2	Band-rumped Storm Petrel	Aves	<i>Oceanodroma</i>
1	0.3	Perching bird or Songbird	Aves	Passeriform – small
4	1.4	Hawaiian Flightless Rail	Aves	<i>Porzana</i> sp.
42	14.5	Christmas Shearwater, Bulwer's Petrel et al.	Aves	Procellariid – small
623	213.2	Wedge-tailed Shearwater, Newell's Shearwater and Hawaiian Petrel	Aves	Procellariid – medium
150	51.3	Hawaiian Petrel	Aves	<i>Pterodroma phaeopygia</i>
0.3	0.1	Unidentifiable	Aves	Small bird
5	1.6	Unidentifiable	Aves	Medium bird – poss. egg shell fragment
7	2.3	Unidentifiable	Aves	Large bird
0.3	0.1	Domestic Dog	Mammalia	<i>Canis familiaris</i>
60	20.8	Domestic Goat/Sheep	Mammalia	<i>Capra hircus/Ovis</i> sp.
8	2.7	Mongoose	Mammalia	<i>Hesperestes auropunctatus</i>
10	3.3	Polynesian Rat	Mammalia	<i>Rattus Exulans</i>
NA	< 0	Norwegian or Roof Rat	Mammalia	<i>Rattus Norvegicus/ Rattus rattus</i>
16	5.4	Unidentifiable	Mammalia	Small mammal
242	82.9	Unidentifiable	Mammalia	Medium mammal
0.6	0.2	Unidentifiable	Osteichthyes	Unidentified fish
4	1.5	Unidentifiable	Indeterminate vertebrate	Unidentifiable

*Concentration Index in grams/m³ Volume = 0.342 m³

The less-frequent bird bone in the inventory includes: Christmas Shearwater (small procellariid), Short-eared Owl (*Asio flammeus*), Band-rumped Storm Petrel (*Oceanodroma castro*), Hawaiian Goose (*Branta sandvicensis*), Hawaiian Flightless Rail (*Porzana* sp.), Perching bird or Songbird (small Passeriform), and possibly Gracile Petrel (*Pterodroma jugabilis*) or Bonin Petrel (*Pterodroma hypoleuca*) (Ziegler 2003). Remains of a small galliform, comparable to a quail, is the only introduced (post-Contact) avian species identified in the faunal inventory.

The small size of the fishbone collected from TU1 suggests the remains were actually stomach contents of the Hawaiian Petrel recently captured in the PTA region after feeding at the ocean (Ziegler 2003). Ziegler also noted phalanx splitting among the Hawaiian Petrel and non-diagnostic medium procellariid bones, possibly indicating Hawaiians chewed raw, salted or cooked bird feet. The presence of egg shell fragments suggests Hawaiians were actively

collecting eggs from nearby burrows or nests used by the Hawaiian Petrel, Hawaiian Goose or Short-eared Owl, or the eggs were indirectly obtained in the ovum of Hawaiian Petrels after the birds were captured for consumption (Zeigler 2003).

Three charcoal samples recovered from SF1d were submitted for radiocarbon assay. The samples consisted of short-lived species: 'akoko (*Chamaesyce* spp.) and longer-living trees: *naio* (cf. *Myoporum sandwicense*) and *mamane* (cf. *Sophora chrysophylla*).

The samples produced the following calibrated (2 σ) date ranges, with multiple date ranges produced from the longer-living tree species (*naio* and *mamane*):

- A.D. 1480 to 1660 ('akoko)
- A.D. 1490 to 1680, A.D. 1770 to 1800, and A.D. 1940 to 1950 (*naio*)
- A.D. 1650 to 1890 and A.D. 1910 to 1950 (*mamane*)

One sample of *naio* (cf. *Myoporum sandwicense*) from SF1f submitted for radiocarbon analysis produced a calibrated (2 σ) date range of AD 1450 to 1660.

Discussion of TU1 Excavation

The TU1 excavation contained a subsurface hearth feature dominated by likely two primary burning episodes: SF1d, a charcoal-mixed ash and *imu* rocks and SF1f, a homogenous charcoal-mixed ash. Both hearth components produced single date ranges between the 14th and 17th centuries, and multiple, probably less-accurate date ranges for SF1d that extend into the 20th century. The post-Contact dates are considered less accurate based on the absence of foreign cultural materials in the hearth feature and surrounding soil layers. The remaining hearth components are alternating layers of ash (gray to pale brown silt), most of which appear mixed or thinly banded possibly as a result of repeated use of the hearth and successive sweep-outs following hearth fires. The culturally-darkened matrices of Layers II and III suggest the deposits are intact cultural layers deposited while the hearth was intermittently unused or they are secondary deposits swept in to extinguish the fire or level the hearth floor, or both.

The 1 m x 1 m unit as a whole yielded an abundance of cultural material, most of which was likely derived from local sources. The primary site activities were reduction of basalt and volcanic glass and preparation and consumption of various types of birds, mainly Hawaiian Petrel who nested in the Saddle, but also smaller procellariids (such as the historically extinct Gracile Petrel or Bonin Petrel), Short-eared Owl (*pueo*), Hawaiian Goose (*nene*), and the extinct Hawaiian Flightless Rail.

The volcanic glass material was likely quarried from the surface of the k4 flow; the closest known quarry site (Site 23458) is roughly 2,000 m to the south (see Figure 10). Some of the constructed tools and utilized flakes might have been used in the butchering of birds prior to cooking (Ziegler 2003).

Site 50-10-31-21308		GANDA Site No:	200
Site Type:	Lava blister	Training Area:	21
Function:	Possible limited-use occupation		
Possible age:	Pre-Contact		
No. of Features:	1		
Site Size:	3.5 m by 2.5 m (0.00008 hectare)		
Cultural Material:	Bird bone		
Condition:	Fair; cave floor impacted by ungulates		
Historical Context:	Traditional Hawaiian occupation (<i>ca.</i> AD 780 to Contact)		
Significance:	D: <i>Information potential</i> ; site may yield important scientific data regarding Hawaiian occupation resource procurement activities in Saddle Region.		
Recommendation:	Avoidance and protection during all SBCT-related projects		

Description: Site 21308 is a lava blister located roughly 130 m east of Redleg Trail. The blister contains a 0.7 m by 1.5 m vertical opening at the center, where it drops down to a lava floor 0.7 m below the surface (Figures 21 and 22). The interior of the blister is roughly 2.5 m by 3.5 m. Uplifted boulders line the inside perimeter on the south, west and north sides. The site boundary is defined by the extent of the lava blister.

The lava blister is tentatively classified as a Hawaiian occupation site based on the presence of four pieces of bird bone on a level soil shelf in the southwest corner of the blister.



Figure 21. Site 21308 Blister Cave

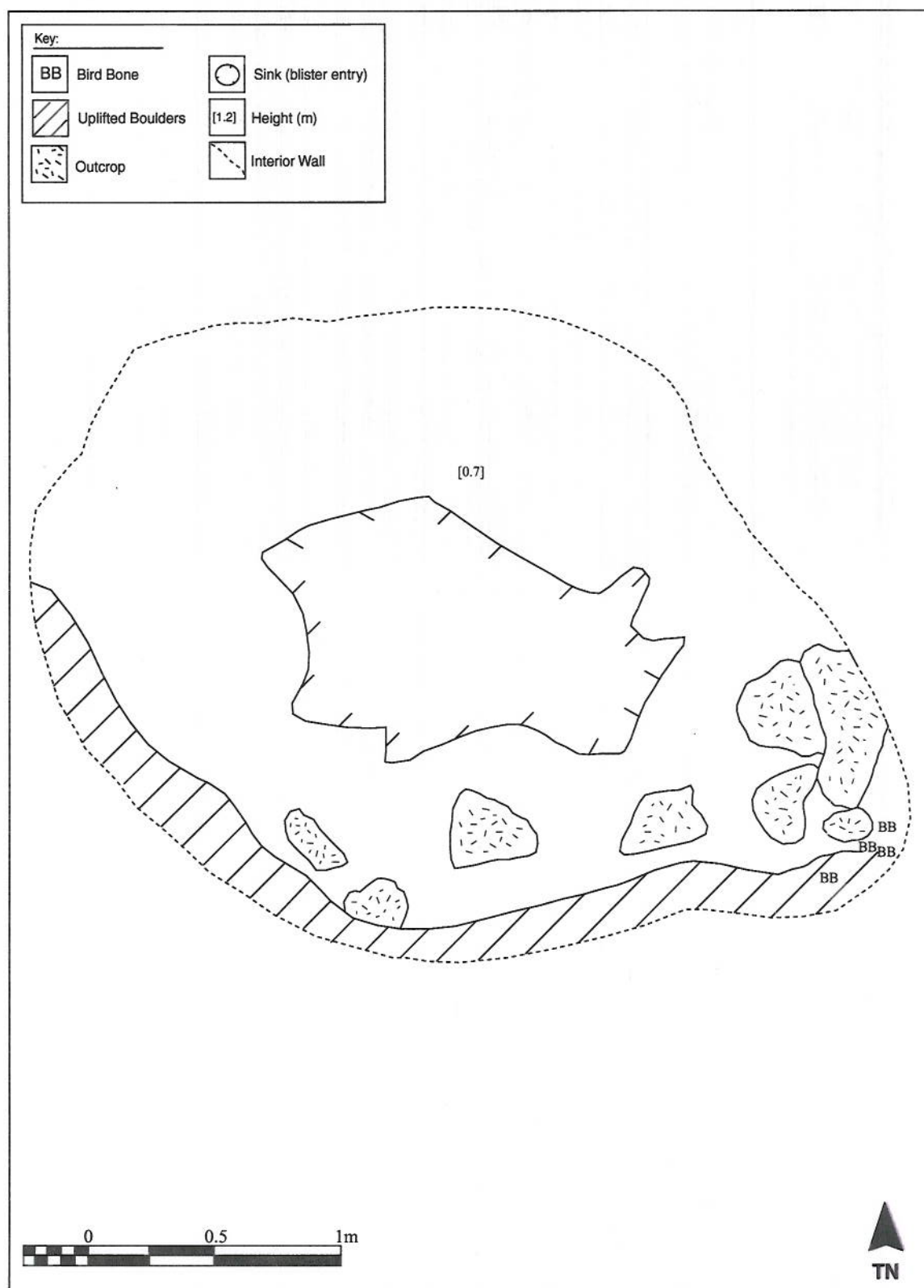


Figure 22. Site 21308; Plan View

Site 50-10-31-23455**GANDA Site No:** 607-615, 689

Site Type:	Excavated pit complex	Training Area:	5
Function:	Possible bird catchments		
Possible age:	Pre-Contact		
No. of Features:	24 in BAX (total 174)		
Site Size:	1,080 m by 775 m (7.7 hectare) (excludes isolated pit roughly 2,250 m west of cluster)		
Cultural Material:	None		
Condition:	Fair; impact from training activities		
Historical Context:	Resource procurement in Saddle Region (Pre-Contact)		
Significance:	D: <i>Information potential</i> ; site yields information (criterion d) regarding possible methods of bird hunting and locations of former habitats.		
Recommendation:	Avoidance and protection during all SBCT-related projects.		

Description: Site 23455 consists of a concentration of 24 excavated pit features in the northeast corner of BAX and an isolated pit roughly 2,250 m to the west (Figures 23 and 24). The site is the westerly extension of a pit complex of at least 174 single and groupings of features previously identified immediately east of BAX (Roberts *et al.* 2004b). The excavated pits are within the k2 lava flow (dating 1,500 to 3,000 years ago) and typically occur in small blisters or caverns beneath the surface.



Figure 23. Photograph of Site 23455, Feature 151.